CLAIMS

What is claimed is:

1. An iterative carrier phase tracking decoding system comprising:

a buffer for buffering a block of symbols;

a serial turbo decoder for providing, during an iteration p, estimates s_k^p of one or more of the buffered symbols, r_k^p, and, optionally, one or more reliability metrics R_k^p, for the one or more estimates, and, after a prescribed number of iterations, estimates of underlying source bits;

a tracking loop module configured, during an iteration p, to (a) determine one or more residuals z_k^p, between the one or more buffered symbols, r_k^p, and the corresponding one or more symbol estimates, s_k^p; (b) optionally weight the residuals with corresponding reliability metrics, R_k^p; and (c) determine one or more derotation phases θ_k^p responsive to one or more of the weighted or unweighted residuals;

a symbol derotator for derotating, during an iteration p, one or more of the buffered symbols, r_k^p, using the one or more derotation phases, θ_k^p, and storing one or more of the derotated symbols, t_k^p, back in the buffer; and

a controller for directing the system to perform one or more iterations.

2. The system of claim 1 further comprising a delay element for compensating at least in part for delay through the serial turbo decoder and the tracking loop module.

3. The system of claim 1 wherein the serial turbo decoder comprises a series combination of a inner SISO, a de-interleaver, an output SISO, and an

interleaver, wherein the inner SISO has an a priori input coupled to the output of the interleaver.

4. The system of claim 3 wherein the inner and outer SISOs are soft output decoders.

5. The system of claim 4 wherein the decoders are log-MAP decoders.

6. The system of claim 3 wherein the symbol estimates are provided by the inner SISO of the serial turbo decoder.

7. The system of claim 3 wherein the symbol estimates are derived from the output of the interleaver of the serial turbo decoder.

8. The system of claim 7 wherein the symbol estimates are derived by passing the output of the interleaver through an encoder and channel symbol mapper that is configured to generate a code that the inner SISO is capable of decoding.

9. The system of claim 1 wherein one or more of the buffered symbols r_k^p are derotated only during selected iterations.

10. The system of claim 1 wherein one or more of the buffered symbols r_k^p are derotated after a prescribed number of iterations.

11. The system of claim 1 wherein one or more of the buffered symbols r_k^p are derotated only during an initial number of iterations.

12. The system of claim 1 wherein the tracking loop module is configured to determine one or more of the derotation phases θ_i^p in accordance with the following equation:

$$\theta_i^{\,p} = \sum_{j=i-W/2}^{j=i+W/2} z_j^{\,p} \bullet w_j$$

where $\sum_{j=i-W/2}^{j=i+W/2} w_j = 1$, W is the size of a window, in terms of number of symbols; $z_j^p$is a residual derived from a comparison of a buffered symbol r_j^p with a corresponding estimate of that symbol s_j^p; and w_j is the weight assigned to the jth residual z_j^p.

13. The system of claim 12 wherein the weights w_j follow a time-domain description of a predefined phase-noise mask.

14. The system of claim 1 wherein the tracking loop module is configured to determine one or more of the derotation phases θ_i^p in accordance with the following expression:

$$\theta_i^{\,p} = \frac{\sum_{j=i-W/2}^{j=i+W/2} z_j^{\,p} \bullet w_j \bullet R_j^{\,p}}{\sum_{j=i-W/2}^{j=i+W/2} w_j \bullet R_j^{\,p}}$$

where W is the size of a window, in terms of number of symbols; z_j^p is a residual derived from a comparison of a buffered symbol r_j^p with a corresponding estimate of the symbol s_j^p; w_j is the weight assigned to the jth residual z_j^p; and R_j^p is a reliability metric for a symbol estimate s_j^p.

15. The system of claim 1 wherein the tracking loop module is configured to determine one or more derotation phases θ_k^p in accordance with the following equation:

$$\theta_k^{\,p} = \sum_{i=1}^{N} a_i \bullet \theta_{k-i}^{\,p} + \sum_{i=0}^{M-1} b_i \bullet R_{k-i}^{\,p} \bullet z_{k-i}^{\,p}$$

where θ_k^p is the derotation phase for the kth symbol during the pth iteration, θ_{k-i}^p represents the derotation phase for the (k-i)th symbol during the pth iteration, a_i is a coefficient applied to θ_{k-i}^p, z_{k-i}^p is a residual derived from a comparison of a symbol r_{k-i}^p with an estimate s_{k-i}^p of that symbol, R_{k-i}^p is the reliability metric for the estimate of the (k-i)th symbol during the pth iteration, b_i is a coefficient applied to $R_{k-i}^p \bullet z_{k-i}^p$, and M and N are non-negative integers.

16. The system of claim 1 wherein one or more residuals z_k^p are phase residuals e_k^p.

17. The system of any of claim 1 wherein one or more residuals z_k^p are orthogonal component residuals y_k^p representing the components of r_k^p orthogonal to s_k^p.

18. A receiver including the system of claim 1.

19. A communications device including the receiver of claim 18.

20. A set-top box comprising the communications device of claim 19.

21. The system of claim 1 wherein the symbol derotator is a modulator.

22. An iterative carrier phase tracking decoding system comprising:

buffer means for buffering a block of symbols;

serial turbo decoding means for providing, during an iteration p, one or more estimates s_k^p of one or more of the buffered symbols r_k^p, and, optionally, one or more reliability metrics R_k^p, for the one or more estimates, and, after a prescribed number of iterations, estimates of underlying source bits;

tracking loop means for, during an iteration p, (a) determining one or more residuals z_k^p between one or more of the buffered symbols, r_k^p and one or more corresponding symbol estimates, s_k^p; (b) optionally weighting the one or more residuals with one or more corresponding reliability metrics, R_k^p; and (c) determining one or more derotation phases θ_k^p, responsive to one or more of the weighted or unweighted residuals;

symbol derotation means for derotating, during an iteration p, one or more of the buffered symbols, r_k^p, using one or more derotation phases, θ_k^p, and storing one or more derotated symbols, t_k^p, back in the buffer; and

control means for directing the system to perform one or more iterations.

23. A method of performing iterative decoding, comprising the following steps:

providing one or more estimates s_k^p of a block of buffered symbols r_k^p;

optionally providing one or more reliability metrics R_k^p for corresponding one or more estimates;

determining one or more residuals z_k^p between one or more buffered symbols r_k^p and one or more symbol estimates s_k^p;

optionally weighting one or more residuals z_k^p with one or more reliability metrics R_k^p;

determining one or more derotation phases θ_k^p responsive to one or more of the weighted or unweighted residuals;

derotating one or more buffered symbols r_k^p using one or more derotation phases θ_k^p;

buffering one or more derotated symbols t_k^p;

if a prescribed number of iterations has not been completed, performing another iteration beginning with the first providing step; and

after a prescribed number of iterations has been completed, providing estimates of underlying source bits.

24. The method of claim 23 further comprising derotating one or more buffered symbols r_k^p only during selected iterations.

25. The method of claim 23 further comprising derotating one or more buffered symbols r_k^p after a prescribed number of iterations.

26. The method of claim 23 further comprising derotating one or more buffered symbols r_k^p only during an initial number of iterations.

27. The method of claim 23 further comprising determining one or more derotation phases θ_i^p in accordance with the following equation:

$$\theta_i^{\,p} = \sum_{j=i-W/2}^{j=i+W/2} z_j^{\,p} \bullet w_j$$

where $\sum_{j=i-W/2}^{j=i+W/2} w_j = 1$, W is the size of a window, in terms of number of symbols; z_j^p is a residual derived from a comparison of a buffered symbol r_j^p with a corresponding estimate of that symbol s_j^p; and w_j is the weight assigned to the jth residual z_j^p.

28. The method of claim 27 wherein the weights w_j follow a time-domain description of a predefined phase-noise mask.

29. The method of claim 23 further comprising determining one or more derotation phases θ_i^p in accordance with the following expression:

$$\theta_i^{\,p} = \frac{\sum_{j=i-W/2}^{j=i+W/2} z_j^{\,p} \bullet w_j \bullet R_j^{\,p}}{\sum_{j=i-W/2}^{j=i+W/2} w_j \bullet R_j^{\,p}}$$

where W is the size of a window, in terms of number of symbols; z_j^p is a residual derived from a comparison of a buffered symbol r_j^p with a corresponding estimate of that symbol s_j^p; w_j is the weight assigned to the jth residual z_j^p; and R_j^p is a reliability metric for the symbol estimate s_j^p.

30. The method of claim 23 further comprising determining one or more derotation phases θ_k^p in accordance with the following equation:

$$\theta_k^{\,p} = \sum_{i=1}^{N} a_i \bullet \theta_{k-i}^{\,p} + \sum_{i=0}^{M-1} b_i \bullet R_{k-i}^{\,p} \bullet z_{k-i}^{\,p}$$

where θ_k^p is the derotation phase for the kth symbol determined during the pth iteration, θ_{k-i}^p represents the derotation phase for the (k-i)th symbol during the pth iteration, a_i is a coefficient applied to θ_{k-i}^p, z_{k-i}^p is a residual derived from a comparison of a symbol r_{k-i}^p with an estimate s_{k-i}^p of that symbol, R_{k-i}^p is the reliability metric for the estimate of the (k-i)th symbol during the pth iteration, b_i is a coefficient applied to $R_{k-i}^p \bullet z_{k-i}^p$, and M and N are non-negative integers.

31. The method of claim 23 wherein one or more residuals z_k^p are phase residuals e_k^p.

32. The method of claim 23 wherein one or more residuals z_k^p are orthogonal component residuals y_k^p representing the components of one or more of the buffered symbols r_k^p orthogonal to corresponding one or more estimates s_k^p.

33. A computer readable medium tangibly embodying the steps of any of the methods of claims 23-32.

34. The medium of claim 33 which is a memory.

35. Circuitry embodying the steps of any of the methods of claims 23-32.

36. The circuitry of claim 35 in a decoder.

37. A synthesized logic circuit which comprises the circuitry of claim 36.

38. An integrated circuit which comprises the circuitry of claim 36.

39. A method of performing iterative decoding, comprising the following steps:

a step of providing one or more estimates s_k^p of one or more buffered symbols r_k^p;

a step of optionally providing one or more reliability metrics R_k^p for one or more estimates;

a step of determining one or more residuals z_k^p between one or more buffered symbols r_k^p and corresponding one or more symbol estimates s_k^p;

a step of optionally weighting one or more residuals z_k^p with one or more corresponding reliability metrics R_k^p;

a step of determining one or more derotation phases θ_k^p responsive to one or more of the weighted or unweighted residuals;

a step of derotating one or more buffered symbols r_k^p using one or more derotation phases θ_k^p;

a step of buffering one or more derotated symbols t_k^p;

if a prescribed number of iterations has not been completed, a step of performing another iteration beginning with the first providing step; and

after a prescribed number of iterations has been completed, a step of providing estimates of underlying source bits.